Noncovalent bonding

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A noncovalent bond is a type of chemical bond, typically between macromolecules, that does not involve the sharing of pairs of electrons, but rather involves more dispersed variations of electromagnetic interactions. The noncovalent bond is the dominant type of bond between supermolecules in supermolecular chemistry.[1] Noncovalent bonds are critical in maintaining the three-dimensional structure of large molecules, such as proteins and nucleic acids, and are involved in many biological processes in which large molecules bind specifically but transiently to one another. The energy released in the formation of noncovalent bonds is on the order of 1-5 kcal per mol.[2] There are four main types of non-covalent bonds: hydrogen bonding, ionic interactions, Van der Waals interactions, and hydrophobic bonds.[2] Examples of noncovalent bonds include: those binding interactions which hold the two strands DNA in the DNA double helix together, those which fold polypeptides into such secondary structures as the alpha helix and the beta conformation, those which enable enzymes to bind to their substrate, and those which enable antibodies to bind to their antigen.[3]

Contents

Overview

In general, *noncovalent bonding* refers to a variety of interactions that are not covalent in nature between molecules or parts of molecules that provide force to hold the molecules or parts of molecules together, usually in a specific orientation or conformation. Noncovalent bonding is the dominant type of bonding in supramolecular chemistry. These noncovalent interactions include: ionic bonds, hydrophobic interactions, hydrogen bonds, Van der Waals forces, i.e. "London dispersion forces", and Dipole-dipole bonds.

The terms "noncovalent bonding," "noncovalent interactions," and "noncovalent forces" all refer to these forces as a whole without specifying or distinguishing which specific forces are involved: noncovalent interactions often involve several of these forces working in concert. Noncovalent bonds are weak by nature and must therefore work together to have a significant effect. In addition, the combined bond strength is greater than the sum of the individual bonds. This is because the free energy

of multiple bonds between two molecules is greater than the sum of the enthalpies of each bond due to entropic effects.

Examples

Protein structure

Main article: Protein structure

Intramolecular noncovalent interactions are largely responsible for the secondary and tertiary structure of proteins and therefore the protein's function in the mechanisms of life. Intermolecular noncovalent interactions are responsible for protein complexes (quaternary structure) where two or more proteins function in a coherent mechanism.

Pharmaceuticals

Most drugs work by noncovalently interacting with biomolecules such as proteins or RNA. Relatively few drugs actually form covalent bonds with the biomolecules they interact with; instead, they interfere with or activate some biological mechanism through noncovalently interacting in very specific locations on specific biomolecules which present the perfect combination of noncovalent binding partners in just the right geometry.

See also

- Ionic bond
- Hydrophobic interactions
- Hydrogen bond
- Van der Waals force
- Intermolecular force

References

1. ^ Noncovalent bonding in Supramolecular Chemistry (http://media.wiley.com/product_data/excerpt/55/35273150/3527315055.pdf) - Christoph A. Schalley
2. ^ [a] [b] Noncovalent bonds (http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=mcb.section.285) – Molecular Cell Biology (textbook), Lodish, Berk, Zipursky, Matsudaira, Baltimore, Darnell.
3. ^ Noncovalent bonding (http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/N/Noncovalent.html) - Kimball's biology (textbook), 1995 ed.

(3) tax-deductible nonprofit charity.